



THE UNIVERSITY *of* EDINBURGH

## Edinburgh Research Explorer

### **Bis(6-chloro-2-pyridonato-N, O)(4,4'- dimethyl-2,2'-bipyridine-N,N')zinc(II) Hydrate at 150 K**

**Citation for published version:**

Mowat, C, Parsons, S, Solan, G & Winpenny, R 1997, 'Bis(6-chloro-2-pyridonato-N, O)(4,4'- dimethyl-2,2'-bipyridine-N,N')zinc(II) Hydrate at 150 K', *Acta Crystallographica Section C - Crystal Structure Communications*, vol. 53, no. Part 3, pp. 282-283. <https://doi.org/10.1107/S0108270196013868>

**Digital Object Identifier (DOI):**

[10.1107/S0108270196013868](https://doi.org/10.1107/S0108270196013868)

**Link:**

[Link to publication record in Edinburgh Research Explorer](#)

**Document Version:**

Publisher's PDF, also known as Version of record

**Published In:**

*Acta Crystallographica Section C - Crystal Structure Communications*

**Publisher Rights Statement:**

Copyright © 1997 International Union of Crystallography; all rights reserved.

**General rights**

Copyright for the publications made accessible via the Edinburgh Research Explorer is retained by the author(s) and / or other copyright owners and it is a condition of accessing these publications that users recognise and abide by the legal requirements associated with these rights.

**Take down policy**

The University of Edinburgh has made every reasonable effort to ensure that Edinburgh Research Explorer content complies with UK legislation. If you believe that the public display of this file breaches copyright please contact [openaccess@ed.ac.uk](mailto:openaccess@ed.ac.uk) providing details, and we will remove access to the work immediately and investigate your claim.



Acta Crystallographica Section C

**Crystal Structure  
Communications**

ISSN 0108-2701

# Bis(6-chloro-2-pyridonato-*N,O*)(4,4'-dimethyl-2,2'-bipyridine-*N,N'*)zinc(II) Hydrate at 150 K

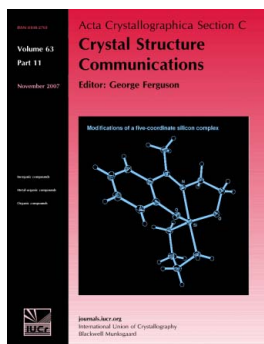
C. G. Mowat, S. Parsons, G. A. Solan and R. E. P. Winpenny

*Acta Cryst.* (1997). **C53**, 282–283

Copyright © International Union of Crystallography

Author(s) of this paper may load this reprint on their own web site or institutional repository provided that this cover page is retained. Republication of this article or its storage in electronic databases other than as specified above is not permitted without prior permission in writing from the IUCr.

For further information see <http://journals.iucr.org/services/authorrights.html>



*Acta Crystallographica Section C: Crystal Structure Communications* specializes in the rapid dissemination of high-quality studies of crystal and molecular structures of interest in fields such as chemistry, biochemistry, mineralogy, pharmacology, physics and materials science. The numerical and text descriptions of each structure are submitted to the journal electronically as a Crystallographic Information File (CIF) and are checked and typeset automatically prior to peer review. The journal is well known for its high standards of structural reliability and presentation. *Section C* publishes approximately 1000 structures per year; readers have access to an archive that includes high-quality structural data for over 10000 compounds.

Crystallography Journals **Online** is available from [journals.iucr.org](http://journals.iucr.org)

Lists of atomic coordinates, displacement parameters, structure factors and complete geometry have been deposited with the IUCr (Reference: AB1414). Copies may be obtained through The Managing Editor, International Union of Crystallography, 5 Abbey Square, Chester CH1 2HU, England.

## References

- Akselrud, L. G., Grin, Y. N., Zavali, P. Y., Pecharsky, V. K. & Fundamunsky, V. S. (1989). XII European Crystallographic Meeting, Moscow. Collected Abstracts, **3**, 155–156.
- Alcock, N. W. & Leviston, P. G. (1974). *J. Chem. Soc. Dalton Trans.* pp. 1834–1836.
- Enraf–Nonius (1989). *CAD-4 Software*. Version 5.0. Enraf–Nonius, Delft, The Netherlands.
- Hitchcock, P. B., Jacobson, B. & Pidcock, A. (1977). *J. Chem. Soc. Dalton Trans.* pp. 2038–2042.
- Hunter, W. N., Muir, K. W. & Sharp, D. W. A. (1986). *Acta Cryst.* **C42**, 1743–1745.
- Johnson, C. K. (1976). *ORTEP*. Report ORNL-5138. Oak Ridge National Laboratory, Tennessee, USA.
- Otto, S. & Roodt, A. (1996). *Acta Cryst.* **C52**, 1636–1638.
- Otto, S., Roodt, A. & Leipoldt, J. G. (1995). *Acta Cryst.* **C51**, 1105–1106.
- Sheldrick, G. M. (1990). *Acta Cryst.* **A46**, 467–473.
- Sheldrick, G. M. (1993). *SHELXL93. Program for the Refinement of Crystal Structures*. University of Göttingen, Germany.
- Streltsov, V. A. & Zavodnik, V. E. (1989). *Kristallographia*, **34**, 1369–1375.
- Watkins, S. F. (1970). *J. Chem. Soc. A*, pp. 168–172.

*Acta Cryst.* (1997). **C53**, 282–283

## Bis(6-chloro-2-pyridonato-*N,O*)(4,4'-dimethyl-2,2'-bipyridine-*N,N'*)zinc(II) Hydrate at 150 K

CHRISTOPHER G. MOWAT, SIMON PARSONS, GREGORY A. SOLAN AND RICHARD E. P. WINPENNY

Department of Chemistry, The University of Edinburgh,  
West Mains Road, Edinburgh EH9 3JJ, Scotland. E-mail:  
s.parsons@ed.ac.uk

(Received 1 October 1996; accepted 7 November 1996)

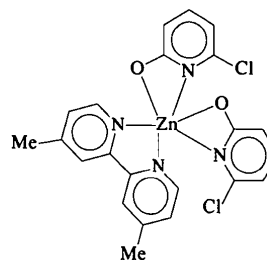
## Abstract

The title compound, bis(6-chloro-2-pyridinolato-*N,O*)-(4,4'-dimethyl-2,2'-bipyridine-*N,N'*)zinc(II) hydrate, [Zn(C<sub>5</sub>H<sub>3</sub>ClNO)<sub>2</sub>(C<sub>12</sub>H<sub>12</sub>N<sub>2</sub>)]·H<sub>2</sub>O, is an example of a pyridonate complex of zinc. The complex has a distorted geometry imposed by the narrow bite angles of the ligands.

## Comment

The pyridonate ligand has been widely used in the coordination chemistry of second and third row transition

metals, but to a lesser degree with the first row metals. Our interest in this ligand with the 3d metals Mn, Fe, Co, Ni and Cu has resulted in a number of unusual structural types (see, for example, Brechin, Harris, Parsons & Winpenny, 1996; Parsons, Solan & Winpenny, 1995). In this paper, we report the preparation and crystal structure of [Zn(chp)<sub>2</sub>(Me<sub>2</sub>-bipy)]·H<sub>2</sub>O, (1)·H<sub>2</sub>O (chp is 6-chloro-2-pyridonate and bipy is 2,2'-bipyridine), which was obtained as part of the extension of our results involving zinc.



(1)

Compound (1) is an example of a pyridone complex of zinc (Fig. 1). While the Zn–N bond lengths to the N atoms (N1 and N1') of the bipyridine ligand adopt normal values and are not significantly different, chemically similar bonds to the pyridonate ligands do differ, by 0.058 (4) Å in the case of Zn–O1R and Zn–O2R, and by 0.136 (4) Å in the case of Zn–N1R and Zn–N2R. The coordination geometry of complex (1) is irregular because of the characteristically narrow bite angles of the ligands, but can be very roughly described as 'distorted octahedral'. The longer Zn–O bond [Zn–O1R 2.097 (3) Å] lies *trans* with respect to Zn–N1 [2.098 (3) Å], while the shorter bond [Zn–O2R 2.039 (3) Å] is *trans* to Zn–N1R [2.237 (3) Å]. This is

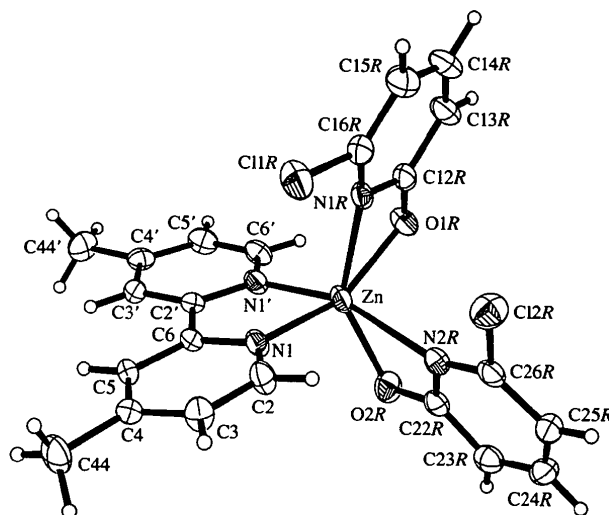


Fig. 1. A view of the title complex with the atom-numbering scheme. Displacement ellipsoids enclose 50% probability surfaces.

consistent with the well known *trans* influence, which explains the difference in the Zn—O bond lengths. The bite angle adopted by bidentate pyridone ligands lies between 57 and 63° in structurally characterized complexes, and so the variation in the Zn—N distances in complex (1) is likely to be a geometric consequence of variation of the Zn—O bond lengths and the requirement for a planar Zn—O—C—N ring system enforced by the in-plane character of the nitrogen lone-pair.

Packing in the crystal structure of (1).H<sub>2</sub>O is characterized by the linking of centrosymmetrically related molecules of (1) by pairs of water molecules *via* hydrogen bonding, with distances O1S...O1R(*x*, *y* − 1, *z*) 2.779 (5) Å and O1S...O2R(1 − *x*, 1 − *y*, 1 − *z*) 2.862 (5) Å. Although planar delocalized ligands, such as those in complex (1), have a tendency to interact *via* graphite-like stacking in solid-state structures, there appear to be no significant interactions of this kind between the hydrogen-bonded dimers, with the shortest intermolecular distance between ring centroids being 4.44 Å.

## Experimental

Hydrated zinc(II) acetate (1.317 g, 6.0 mmol) was mixed intimately with a slightly greater than twofold excess of 6-chloro-2-hydroxypyridine (1.71 g, 13.2 mmol). The mixture was fused at 413 K under N<sub>2</sub> and after 1 h the acetic acid formed during the reaction was removed *in vacuo* and the unreacted chp removed by sublimation. The colourless product was dissolved in dichloromethane, filtered and then mixed with 4,4'-dimethyl-2,2'-bipyridine (1.140 g, 6.0 mmol). After stirring for 3 h, the colourless solution was filtered, concentrated and layered with diethyl ether to yield, after several days, colourless crystals suitable for X-ray analysis.

### Crystal data

[Zn(C<sub>5</sub>H<sub>3</sub>ClNO)<sub>2</sub>·  
(C<sub>12</sub>H<sub>12</sub>N<sub>2</sub>)]·H<sub>2</sub>O  
*M<sub>r</sub>* = 524.69  
Triclinic  
*P*1̄  
*a* = 8.995 (6) Å  
*b* = 9.748 (7) Å  
*c* = 14.655 (11) Å  
*α* = 97.39 (5)°  
*β* = 99.85 (5)°  
*γ* = 113.16 (3)°  
*V* = 1136.5 (14) Å<sup>3</sup>  
*Z* = 2  
*D<sub>x</sub>* = 1.533 Mg m<sup>−3</sup>  
*D<sub>m</sub>* not measured

### Data collection

Stoe Stadi-4 diffractometer  
equipped with an Oxford  
Cryosystems variable  
temperature device (Cosier  
& Glazer, 1986)

Mo *Kα* radiation  
*λ* = 0.71073 Å  
Cell parameters from 24  
reflections  
*θ* = 15–16°  
*μ* = 1.348 mm<sup>−1</sup>  
*T* = 150.0 (2) K  
Block  
0.58 × 0.27 × 0.23 mm  
Colourless

4022 independent reflections  
3023 reflections with  
*I* > 2σ(*I*)  
*R*<sub>int</sub> = 0.0593  
*θ*<sub>max</sub> = 25.02°

ω-*θ* scans

Absorption correction:

ψ scans (North, Phillips  
& Mathews, 1968)

*T*<sub>min</sub> = 0.645, *T*<sub>max</sub> = 0.714  
5899 measured reflections

### Refinement

Refinement on *F*<sup>2</sup>

*R*(*F*) = 0.0443

*wR*(*F*<sup>2</sup>) = 0.1086

*S* = 1.031

4017 reflections

295 parameters

H atoms riding, *U*(H) =  
1.2*U*<sub>eq</sub>(C)

*h* = −10 → 10

*k* = −11 → 11

*l* = 0 → 17

3 standard reflections

frequency: 60 min

intensity decay: 5%

*w* = 1/[σ<sup>2</sup>(*F*<sub>o</sub><sup>2</sup>) + (0.058*P*)<sup>2</sup>  
+ 0.1993*P*]

where *P* = (*F*<sub>o</sub><sup>2</sup> + 2*F*<sub>c</sub><sup>2</sup>)/3

(Δ/σ)<sub>max</sub> = 0.001

Δρ<sub>max</sub> = 0.485 e Å<sup>−3</sup>

Δρ<sub>min</sub> = −0.793 e Å<sup>−3</sup>

Extinction correction: none

Scattering factors from

*International Tables for  
Crystallography* (Vol. C)

Table 1. Selected geometric parameters (Å, °)

Zn—O2R	2.039 (3)	Zn—N1	2.098 (3)
Zn—N1'	2.091 (3)	Zn—N1R	2.237 (3)
Zn—O1R	2.097 (3)	Zn—N2R	2.373 (3)
O2R—Zn—N1'	104.47 (12)	O1R—Zn—N1R	61.72 (12)
O2R—Zn—O1R	98.85 (12)	N1—Zn—N1R	97.72 (13)
N1'—Zn—O1R	96.84 (12)	O2R—Zn—N2R	60.62 (11)
O2R—Zn—N1	104.38 (13)	N1'—Zn—N2R	161.43 (11)
N1'—Zn—N1	78.48 (13)	O1R—Zn—N2R	96.50 (11)
O1R—Zn—N1	156.75 (11)	N1—Zn—N2R	94.00 (12)
O2R—Zn—N1R	143.74 (11)	N1R—Zn—N2R	89.80 (11)
N1'—Zn—N1R	107.92 (12)		

Data collection: *DIF4* (Stoe & Cie, 1990). Cell refinement: *DIF4*. Data reduction: *XRED* (Stoe & Cie, 1994). Program(s) used to solve structure: *SHELXS86* (Sheldrick, 1990). Program(s) used to refine structure: *SHELXL93* (Sheldrick, 1993). Molecular graphics: *SHELXTL* (Sheldrick, 1995).

The authors thank the EPSRC for provision of a four-circle diffractometer.

Lists of atomic coordinates, displacement parameters, structure factors and complete geometry have been deposited with the IUCr (Reference: CF1147). Copies may be obtained through The Managing Editor, International Union of Crystallography, 5 Abbey Square, Chester CH1 2HU, England.

## References

- Brechin, E. K., Harris, S. G., Parsons, S. & Winpenny, R. E. P. (1996). *Chem. Commun.* pp. 1439–1440.
- Cosier, J. & Glazer, A. M. (1986). *J. Appl. Cryst.* **19**, 105–108.
- North, A. C. T., Phillips, D. C. & Mathews, F. S. (1968). *Acta Cryst.* **A24**, 351–359.
- Parsons, S., Solan, G. A. & Winpenny, R. E. P. (1995). *J. Chem. Soc. Chem. Commun.* pp. 1987–1988.
- Sheldrick, G. M. (1990). *Acta Cryst.* **A46**, 467–473.
- Sheldrick, G. M. (1993). *SHELXL93. Program for the Refinement of Crystal Structures*. University of Göttingen, Germany.
- Sheldrick, G. M. (1995). *SHELXTL*. Version 5.0. Siemens Analytical X-ray Instruments Inc., Madison, Wisconsin.
- Stoe & Cie (1990). *DIF4. Diffractometer Control Program*. Version 7.09/DOS. Stoe & Cie, Darmstadt, Germany.
- Stoe & Cie (1994). *XRED. Data Reduction Program*. Version 1.04. Stoe & Cie, Darmstadt, Germany.